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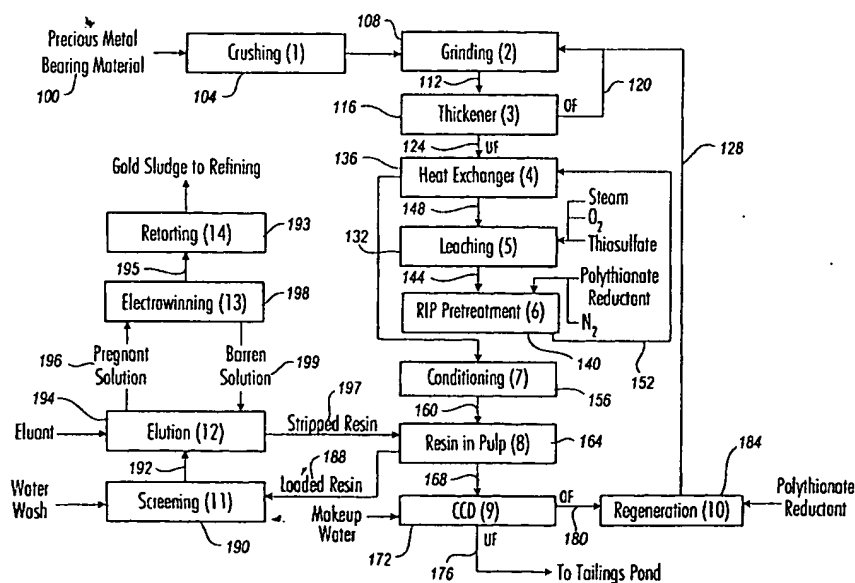
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(54) Title: **METHOD FOR THIOSULFATE LEACHING OF PRECIOUS METAL-CONTAINING MATERIALS**



(57) Abstract: Processes are provided for recovering precious metals from refractory materials using thiosulfate lixiviants. The processes can employ lixiviants that include at most only small amounts of copper and/or ammonia and operate at a relatively low pH, reduction of polythionates, inert atmospheres to control polythionate production, and electrolytic solutions which provide relatively high rates of precious metal recovery.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 01/01119

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 C22B11/00 C22B3/08 C22B3/00 C22B3/26 C22B3/42
C22B3/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C22B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 316 094 A (BRITISH PETROLEUM CO PLC) 17 May 1989 (1989-05-17)	1,4,7, 14,26, 27,31, 32, 36-41, 44-46, 53,59, 66,72, 76,84 22,30, 42,73,85
A	abstract page 2, line 2 - line 3 page 2, line 18 - line 52 page 3, line 7 - line 19 claims 1,3-5; figure; tables ----- -/--	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
 E earlier document but published on or after the international filing date
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- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
 X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
 Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
 Z document member of the same patent family

Date of the actual completion of the international search

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Name and mailing address of the ISA

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 01/01119

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 5 785 736 A (FLEMING CHRISTOPHER ET AL) 28 July 1998 (1998-07-28) cited in the application the whole document	54,55 1-7,26, 38,47, 56-59, 73, 77-79,84
X A	US 4 778 519 A (PESIC BATRIC) 18 October 1988 (1988-10-18) column 1, line 12 - line 19 column 3, line 15 - column 4, line 30 column 8, line 1 - line 14 column 10, line 3 - line 52	8-10 12,13
X A	US 5 354 359 A (WAN RONG-YU ET AL) 11 October 1994 (1994-10-11) column 1, line 11 - line 14 column 7, line 45 - column 8, line 4 column 8, line 52 - line 68	8 9,10
X A	US 4 070 182 A (GENIK-SAS-BEREZOWSKY ROMAN M ET AL) 24 January 1978 (1978-01-24) the whole document	67,68 8-13, 22-24,71
X A	AU 18525 99 A (PLACER DOME, INC.) 16 September 1999 (1999-09-16) cited in the application page 13, line 9 - page 14, line 25 claims 1,7,16,19; figures	8 10,22
X A	US 4 369 061 A (KERLEY JR. BERNARD J) 18 January 1983 (1983-01-18) abstract column 2, line 15 - line 31 column 2, line 60 - line 68 column 3, line 48 - line 55 column 5, line 44 - column 6, line 29	15, 17-20, 67,80-83 68-71
X A A	US 5 876 588 A (MENARD HUGUES ET AL) 2 March 1999 (1999-03-02) column 2, line 20 - line 25 column 2, line 44 - column 3, line 4 US 5 536 297 A (FLEMING CHRISTOPHER ET AL) 16 July 1996 (1996-07-16) cited in the application the whole document	60 61,64,65 1-7,26, 38,47, 73,84

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 01/01119

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 95 04164 A (NEWMONT GOLD CO ; NEWMONT MINING CORP (US)) 9 February 1995 (1995-02-09) the whole document ---	1-7, 26, 38, 73, 84
A	US 4 654 078 A (PEREZ ARIEL E ET AL) 31 March 1987 (1987-03-31) the whole document ---	67, 95
A	US 4 296 075 A (YAN TSOUNG-YUAN) 20 October 1981 (1981-10-20) the whole document ---	47, 54, 88
P, A	WO 01 23626 A (MALLEY GLEN PETER O ; UNIV MURDOCH (AU)) 5 April 2001 (2001-04-05) claims 1, 2, 8 ---	77-79
E	AU 31355 01 A (BARRICK GOLD CORP) 11 October 2001 (2001-10-11) cited in the application the whole document -----	8-13, 47-52

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 01/01119

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-7,14,26-46,53,59,66,72-76,84-87

Process for recovering a precious metal from a precious metal-containing material, comprising the step of contacting the precious metal-containing material with a thiosulfate lixiviant at superatmospheric pressure.

2. Claims: 8-13

Process for recovering a precious metal from a carbonaceous precious metal-containing material, comprising the step of contacting the precious metal-containing material with a thiosulfate lixiviant with (almost) no added copper and ammonia.

3. Claims: 15-21,47-52,54-58,80-83,88-94

Process for recovering a precious metal from a precious metal-containing material, comprising the step of contacting the precious metal-containing material with a thiosulfate lixiviant and converting the formed polythionates to thiosulfate.

4. Claims: 22-25

Process for recovering a precious metal from a precious metal-containing material, comprising the step of contacting the precious metal-containing material with a lixiviant in 2 steps at different oxygen partial pressure.

5. Claims: 60-65

Process for recovering a precious metal from a precious metal-containing material, comprising the step of contacting the precious metal-containing material with a lixiviant and electrowinning the precious metal from the pregnant leach solution.

6. Claims: 67-71

Process for recovering a precious metal from a precious metal-containing material, comprising the step of contacting the precious metal-containing material with a thiosulfate lixiviant and inhibiting the formation of polythionates.

7. Claims: 77-79

FURTHER INFORMATION CONTINUED FROM PCT/SA/ 210

Process for recovering a precious metal from a precious metal-containing material, comprising the step of contacting the precious metal-containing material with a thiosulfate lixiviant and contacting the pregnant leach solution with an adsorbent.

8. Claims: 95-96

Process for recovering a precious metal from a precious metal-containing material, comprising the step of contacting the precious metal-containing material with a thiosulfate lixiviant and inhibiting reaction between thiosulfate and metal impurity after leaching.

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/IB 01/01119

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0316094	A	17-05-1989	AU 2452388 A	11-05-1989
			BR 8805792 A	01-08-1989
			EP 0316094 A2	17-05-1989
			JP 1156432 A	20-06-1989
			ZA 8808187 A	25-07-1990
US 5785736	A	28-07-1998	US 5536297 A	16-07-1996
			CA 2209559 A1	16-01-1998
			CA 2169140 A1	11-08-1996
US 4778519	A	18-10-1988	US 4816235 A	28-03-1989
US 5354359	A	11-10-1994	AU 685755 B2	29-01-1998
			AU 4925793 A	28-02-1995
			BR 9307876 A	06-08-1996
			CA 2167571 A1	09-02-1995
			CN 1098142 A ,B	01-02-1995
			EP 0712445 A1	22-05-1996
			MX 9305978 A1	31-01-1995
			RU 2125107 C1	20-01-1999
			WO 9504164 A1	09-02-1995
			ZA 9307288 A	25-04-1994
			ZW 13193 A1	25-05-1994
US 4070182	A	24-01-1978	CA 1073681 A1	18-03-1980
			AU 499658 B2	26-04-1979
			AU 2246177 A	24-08-1978
			ZA 7700840 A	28-12-1977
AU 1852599	A	16-09-1999	US 6251163 B1	26-06-2001
			ZA 9901710 A	04-12-2000
US 4369061	A	18-01-1983	US 4269622 A	26-05-1981
			CA 1148748 A1	28-06-1983
			ZA 8007196 A	26-08-1981
US 5876588	A	02-03-1999	CA 2193305 A1	18-06-1998
US 5536297	A	16-07-1996	CA 2169140 A1	11-08-1996
			US 5785736 A	28-07-1998
WO 9504164	A	09-02-1995	US 5354359 A	11-10-1994
			AU 685755 B2	29-01-1998
			AU 4925793 A	28-02-1995
			BR 9307876 A	06-08-1996
			CA 2167571 A1	09-02-1995
			CN 1098142 A ,B	01-02-1995
			EP 0712445 A1	22-05-1996
			MX 9305978 A1	31-01-1995
			RU 2125107 C1	20-01-1999
			WO 9504164 A1	09-02-1995
			ZA 9307288 A	25-04-1994
			ZW 13193 A1	25-05-1994
US 4654078	A	31-03-1987	NONE	
US 4296075	A	20-10-1981	AU 523931 B2	19-08-1982
			AU 5017779 A	29-05-1980

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/IB 01/01119

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4296075 A		CA 1137320 A1 ZA 7905253 A	14-12-1982 27-05-1981
WO 0123626 A	05-04-2001	WO 0123626 A1 AU 7889500 A	05-04-2001 30-04-2001
AU 3135501 A	11-10-2001	US 6344068 B1	05-02-2002